The Application of Simple Additive Weighting Method in the Selection of the Islamic Competition Winners

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ARTICLE INFO

Article history
Received 15 August 2019
Revised 18 September 2019
Accepted 3 October 2019

Keywords
Decision support system
Winner selection
Islamic competition
Simple additive weighting

ABSTRACT

The IRMA Islamic Competition is an Islamic contest held by mosque youth association (IRMA) of the Baitul Muttaqien Mosque at Dolog Housing. Currently, the calculation and ranking method is still conducted manually, and it takes a long time. The data recording process also still using a paper which at any time the recorded data can be damaged or lost before the announcement of the winners of the competition. This study aims to build a decision support system for the selection of the winners of the IRMA Islamic Competition. The simple additive weighting (SAW) method was used to be implemented in the system. The results of the study show that the use of the SAW method effectively helps the committee to easily determine the winners of the competition.

1. Introduction

Speaking about the issue of character education in Indonesia, the Indonesia education system need to be revisited to be able to create a superior, honest, responsible, noble people that have a humanitarian spirit and care for one another. Some characters, such as honesty, politeness, togetherness and religious slowly fade and switched by foreign cultures that further highlight hedonistic, materialistic and individualistic attitudes. Currently, religious education is an essential subject to create generations with noble character, good personality, discipline, and healthy both spiritually and physically. The mental spirit can only be achieved through mental and spiritual development. It would be better if this religious education is instilled in early childhood so that later they would be useful for their nation and religions. Moreover, education should apply certain methods that build children's creativity and mental development, one of which is organizing Islamic competitions for early childhood.

Given these facts, the mosque youth association (IRMA) of the Baitul Muttaqien Mosque at Dolog housing has taken an initiative to hold an Islamic competition that is always held to commemorate the birth of the Prophet Muhammad SAW and *Isra'Mi'raj*. The IRMA Islamic competition has determined some criteria to select the winners. However, there are many obstacles faced by the committee in determining the winners. In this regard, the winner selection is still performed conventionally. The process of writing data and its calculation are conducted manually. This conventional method causes some problems, for example, before the announcement of the winners, there could be damage or loss of competition assessment data because the score recording is still done on a piece of paper. Therefore, we need a decision support system that can help IRMA in selecting the winners of the competition effectively.

A study conducted by Harold (2015) used a simple additive weighting (SAW) method to select prospective science Olympiad candidates at Madrasah Aliyah Negeri 2 Tanjung Pura of Langkat regency. The SAW method has been proven capable of being used as an appropriate approach to select students who are eligible to become a science Olympiad candidate. The same results were also shown in the research for the selection of the outstanding teachers at SMA Negeri 2 Kutacane (Gunawan, 2015). Gunawan applied the SAW into the decision support system (DSS). The DSS was

succeeded in determining the outstanding teachers. Gunawan stated that by implementing a computerized system in the selection process, the data processing would be more precise and reduced errors in calculating grades to obtain more specific ranking results.

Therefore, in this study, the SAW method is employed since it is considered as an appropriate approach in deciding the winners of the Islamic competition. The decision is determined by the weight value for each attribute and preceded with the ranking process. In addition, the advantage of the SAW method compared to other decision-making methods lies in its ability to do more precise assessments because it is based on the value of criteria and weight of pre-determined preferences.

2. Literature Review

2.1. System

A system is basically a group of elements that are closely related to each other, which function together to achieve certain goals. From this definition, it can be further detailed the understandings of the system in general as follows.

2.2. Decision Support System

The DSS is usually built to support the solution of a problem or for an opportunity. The DSS application is used in a decision-making process. The DSS uses computer-based information systems (CBIS) that are flexible, interactive, and adaptable, which are developed to support the solutions to specific unstructured management problems.

The Decision Support System with a CBIS can help a person to improve his performance in the decision-making process. So, a computer-based decision support system can be used for the management of decision-making related to the existing problems.

2.3. Simple Additive Weighting (SAW)

The SAW method is also known as the weighted sum method. The basic concept of the SAW is to find the weighted sum of the performance ratings of each alternative on all attributes. This method requires the process of normalization of the decision matrix (x) to a scale that is compared with all existing alternative ratings (Munthe, 2013).

The mathematics formula for the normalization process in the Simple Additive Weighting (SAW) is shown in formula 1.

$$r_{ij} = \begin{cases} \frac{x_{ij}}{Max_i(x_{ij})}, if\ j\ is\ the\ atribute\ of\ benefit \\ \frac{Min_i(x_{ij})}{x_{ij}},\ if\ j\ is\ the\ atribute\ of\ cost \end{cases} \quad (1)$$

Note:

r_{ij} = value of normalized performance rating
x_{ij} = attributive value owned by each criterion
Max = maximum value of each row and column
Min = minimum value of each row and column
$benefit$ = if the highest value is the best
$cost$ = if the lowest value is the best

with r_{ij} is the normalized performance rating from alternative Ai on attribute Cj;

$i = 1,2,\ldots,m$ and $j = 1,2,\ldots,n$.

Preference value for each alternative (V_i) is explained as follows on formula 2

$$V_i = \sum_{j=1}^{n} w_j\, r_{ij} \quad (2)$$

Note:
V_i = benefit ranking for each alternative
w_j = value of ranking weight from each criterion
r_{ij} = value of normalized performance rating

Higher V_i value indicates alternative Ai is more favorable.

2.4. Unified Model Language (UML)

UML is a modeling language for the systems or software that has an "object-oriented" paradigm. Modeling is actually used to simplify complex problems such that it is easier to learn and understand. The diagrams in the UML are use case diagrams, class diagrams, activity diagrams, and sequence diagrams.

2.5. Hypertext Mark-up Language (HTML)

HTML is a basic programming language for the web that is client-side and makes it possible to display information in the form of text, graphics, and multimedia and also to connect between web views (hyperlinks).

2.6. Hypertext Preprocessor (PHP)

PHP is a program that is widely used for handling, creating and developing web and can be used in HTML. PHP is a language that works on the server-side. The PHP syntax and commands are given entirely on the server-side and will not appear on the client-side.

2.7. MySQL

MySQL is a database creation program that is open source, meaning that all people/communities/companies can use, develop, and run it on all platforms such as Windows, Linux, and Mac OS. MySQL is also the software that is networked so that it can be used for multiuser applications (many users).

2.8. Notepad++

Notepad++ is an application that has useful features for programmers or developers in making programs. Notepad++ uses the Scintilla component to be able to display and edit texts and source code files in various programming languages.

3. Method

This section outlines the methodology of the research comprises types of data, data collection, and system development methods.

3.1. Types of data

The primary and secondary data were two types of data used in the current study. The primary data were collected directly from the source, i.e. the winner decision system and the problems that existed in the current system. Meanwhile, the secondary data were obtained indirectly from the research objects and literature studies and other sources to support the primary data.

3.2. Data Collection Methods

Several collecting data techniques were used in the current study including interviews, observation, and literature. The interview is one of the data collection techniques to obtain information by communicating directly with the relevant respondents. We interviewed Mr. Muhammad Tosan Bingamawa (the Chairperson of the IRMA Baitul Muttaqien) and other related parties to obtain relevant data. The observation was another technique used to collect the data. The observation was conducted by observing the research subject in the field. With respect to this, we examined how the current system was closely related to the decision making of the winners of the IRMA Islamic competition. The literature method was carried out by studying some written sources, such as research journals related to decision support systems.

3.3. System Development Method

The study used a prototype method in developing the DSS. In the development of a system, the customers often imagined a collection of desired needs but were not specified in detail, in terms of inputs, processes, and outputs. On the other hand, a software developer must specify a need in detail from its engineering aspect where the customers usually did not yet understand this technical matter. The prototype model could be used to connect the customers' misunderstanding about the technical matter and clarify the specifications of the customers' desired requirements to the software developers. The following are the stages in the prototype method described in Figure 1.

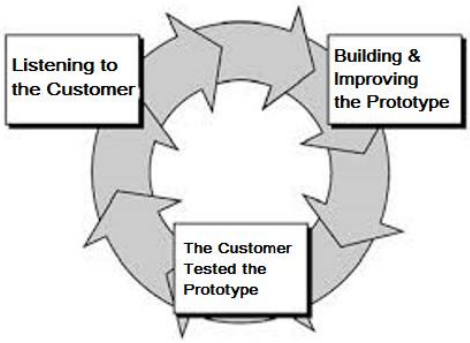

Figure 1. Prototype method

The stages of the prototype method were explained as follows:

1. Listening to the customers
   The prototype method started with the communication between the system developer and the users or end-users of the system that would be created later. Here, the researchers conducted some meetings and interview with Mr. Muhammad Tosan Bingamawa as the chairman of IRMA Baitul Muttaqien as the main informant to define the system to be made and took some data to build a decision support system that would be built later.
2. Building and improving the prototype
   After conducting the interview with the informant, the next step was to build and improve the prototype. At this stage, the researchers built a prototype initiated by designing a prototype using UML, then the prototype was built with PHP web programming with a database using MySQL
3. The customers tested the prototype
   After the prototype was complete, the next step was to test the prototype. At this stage, the researchers submitted the system prototype that had been made to the customers for an evaluation and then provided feedback to the researchers. If the prototype that had been made was considered not as expected, the researchers would improve the prototype according to the customers' needs.

4. Results and Discussion

4.1. System Design

To build a DSS for the selection of IRMA Islamic competition winners in the Baitul Muttaqien Mosque using a simple additive weighting method, UML design is required (Nugroho, 2011; Pratiwi, 2016). The UML includes a use case diagram, class diagrams, sequence diagram, and activity diagram.

4.1.1. Use case diagram

The use case diagram of the DSS for the selection of IRMA Islamic Competition in the Baitul Muttaqien Mosque comprises one actor and 12 use cases as depicted in Figure 2.

Figure 2. Use case diagram of DSS for the selection of the winners

In Figure 2, an admin can manage Edit Sub Kriteria, Edit Kriteria Hafalan Surat Pendek, Edit Kriteria Tilawah, Edit Kriteria Adzan, Edit Kriteria Kaligrafi, Lomba Kelola Nilai Peserta Lomba Hafalan Surat Pendek, Kelola Nilai Peserta Lomba Tilawah, Kelola Nilai Peserta Lomba Adzan, Kelola Nilai Peserta Lomba Kaligrafi, Lihat Laporan, Cetak Laporan, Kelola Daftar Laporan

4.1.2. *Class diagram*

The class diagram in the DSS for the selection of IRMA Islamic Competition winners at the Baitul Muttaqien Mosque has 12 classes as presented in Figure 3.

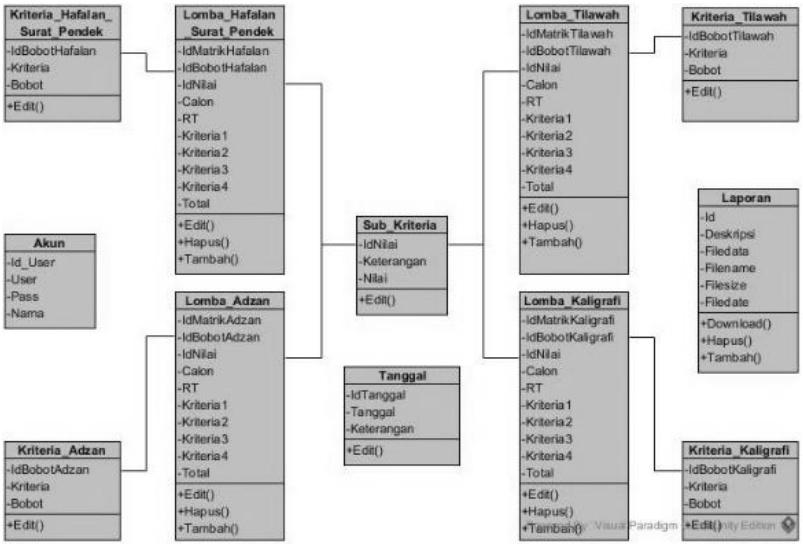

Figure 3. Class diagram of DSS for the selection of the winners

Figure 3 shows 12 classes, namely Akun, Sub_Kriteria, Kriteria_Hafalan_Surat_Pendek, Kriteria_Tilawah, Kriteria_Adzan, Kriteria_Kaligrafi, Lomba_Hafalan_Surat_Pendek, Lomba_Tilawah, Lomba_Adzan, Lomba_Kaligrafi, Tanggal and Laporan. The DSS for the selection of the winners of IRMA Islamic competition in the Baitul Muttaqien Mosque with the SAW method used MySQL database (Kristanto, 2010).

4.1.3. Sequence diagram

The sequence diagram illustrates the process of scenario in the use case by describing the lifetime of objects and messages sent and received among objects (Nugroho, 2011). The following is the sequence diagram of the management of the participants of the Quran recitation competition.

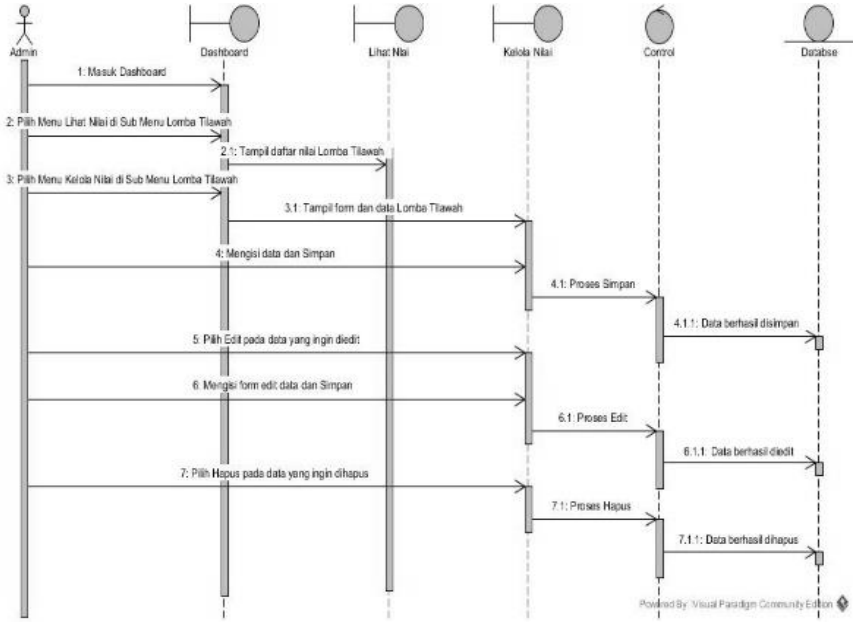

Figure 4. Sequence diagram of manage participant's scores

In Figure 4, the sequence diagram illustrates the process of the scenario in managing the scores of the participants in the recitation competition. Such a sequence diagram condition occurs if the admin has successfully entered the system. In the sequence diagram, the admin is able to view, edit, add and delete the data.

4.1.4. Activity diagram

The activity diagram illustrates the flow of activities of a system (Nugroho, 2011). The activity flow in the activity diagram manages the value of the participant in the recitation competition if the admin has successfully entered the system and is on the dashboard. Figure 5 illustrates the process of managing the scores of participants in the recitation competition Islamic Competition winners at the Baitul Muttaqien Mosque using the simple additive weighting method.

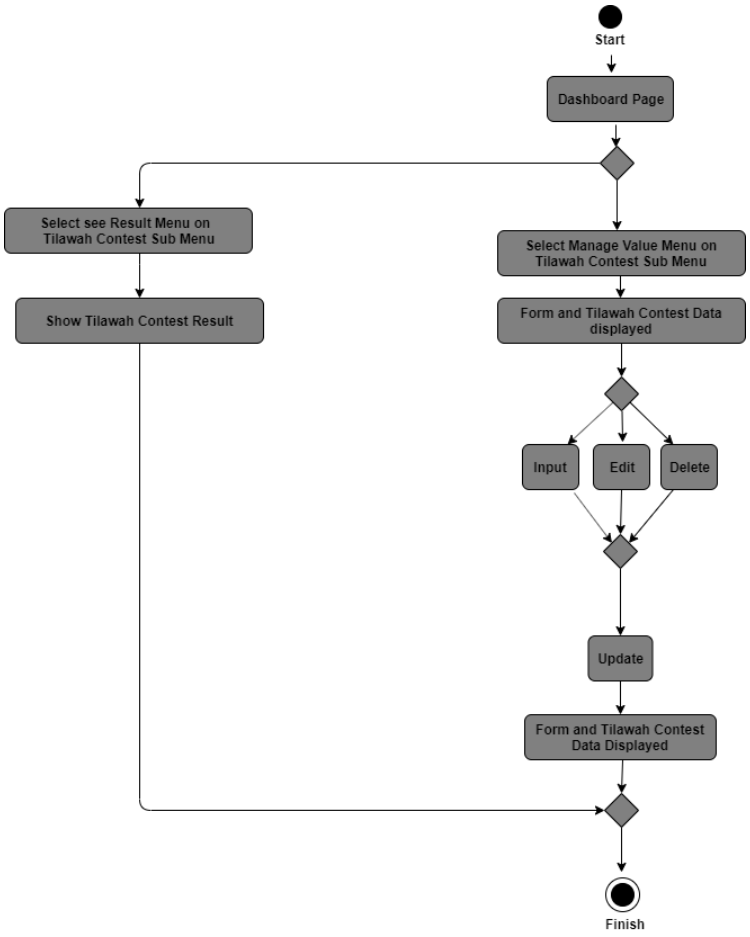

Figure 5. Activity diagram

4.2. Criteria and Weights

In the SAW method which is applied to the decision support system of the selection of IRMA Islamic competition winners, certain criteria are required to search for or select the winners of the competition. The criteria and weights required are as follows:

1. The criteria and weights of short surah Quran memorization contest are shown in Table 1:

Table 1. Criteria and weights of short surah Quran memorization contest

Code	Criteria	Weight
C1	*Makhraj* and *Tajwid*	35%
C2	Intonation	15%
C3	Fluently	25%
C4	Attitude	25%

2. The criteria and weights of Quran recitation competition are shown in Table 2

Table 2. Criteria and weights of Quran recitation competition

Code	Criteria	Weight
C1	*Makhraj* and *Tajwid*	25%
C2	Rhythm	25%
C3	Fluently	25%
C4	Attitude	25%

3. The criteria and weights of *adzan* competition are shown in Table 3

Table 3. Criteria and weights of *adzan* competition

Code	Criteria	Weight
C1	*Makhraj* and *Tajwid*	35%
C2	Rhythm	25%
C3	Concentration	25%
C4	Attitude	15%

4. The criteria and weights of calligraphy competition are shown in Table 4

Table 4. Criteria and weights of a calligraphy competition

Code	Criteria	Weight
C1	Letter Accuracy	25%
C2	Neatness	20%
C3	Design	30%
C4	Colour Combination	25%

4.3. Sub Criteria and Weights

Table 5 presents the sub-criteria given to each criterion for every competition.

Table 5. Sub criteria for each criterion

Sub Criteria	Weight
Very Good	1
Good	0.8
Fair	0.65
Low	0.5
Very Low	0.25

The following is an example of a calculation using the SAW method for the selection of IRMA Islamic competition winners in the recitation competition

Table 6 contains the data of the participants and their scores on the *Quran* recitation competition.

Table 6. Scores for Quran recitation competition

Name	RT	C1	C2	C3	C4
Wuri	08	0,8	0,65	0,8	0,8
Mahmudah	08	0,8	0,65	0,8	0,65
Nurista	09	1	0,8	0,8	0,8
Natsha	09	1	1	0,8	0,8
Febrio	05	1	0,8	1	0,65

The value of normalization is then calculated, as follows:

Normalization Matrix (r)

1. Criteria C1

$$r_{11} = \frac{0.8}{\max\{0.8; 0.8; 1; 1; 1\}} = \frac{0.8}{1} = 0.8$$

$$r_{21} = \frac{0.8}{\max\{0.8; 0.8; 1; 1; 1\}} = \frac{0.8}{1} = 0.8$$
$$r_{31} = \frac{1}{\max\{0.8; 0.8; 1; 1; 1\}} = \frac{1}{1} = 1$$
$$r_{41} = \frac{1}{\max\{0.8; 0.8; 1; 1; 1\}} = \frac{1}{1} = 1$$
$$r_{51} = \frac{1}{\max\{0.8; 0.8; 1; 1; 1\}} = \frac{1}{1} = 1$$

2. Criteria C2

$$r_{12} = \frac{0.65}{\max\{0.65; 0.65; 0.8; 1; 0.8\}} = \frac{0.65}{1} = 0.65$$
$$r_{22} = \frac{0.65}{\max\{0.65; 0.65; 0.8; 1; 0.8\}} = \frac{0.65}{1} = 0.65$$
$$r_{32} = \frac{0.8}{\max\{0.65; 0.65; 0.8; 1; 0.8\}} = \frac{0.8}{1} = 0.8$$
$$r_{42} = \frac{1}{\max\{0.65; 0.65; 0.8; 1; 0.8\}} = \frac{1}{1} = 1$$
$$r_{52} = \frac{0.8}{\max\{0.65; 0.65; 0.8; 1; 0.8\}} = \frac{0.8}{1} = 0.8$$

3. Criteria C3

$$r_{13} = \frac{0.8}{\max\{0.8; 0.8; 0.8; 0.8; 1\}} = \frac{0.8}{1} = 0.8$$
$$r_{23} = \frac{0.8}{\max\{0.8; 0.8; 0.8; 0.8; 1\}} = \frac{0.8}{1} = 0.8$$
$$r_{33} = \frac{0.8}{\max\{0.8; 0.8; 0.8; 0.8; 1\}} = \frac{0.8}{1} = 0.8$$
$$r_{43} = \frac{0.8}{\max\{0.8; 0.8; 0.8; 0.8; 1\}} = \frac{0.8}{1} = 0.8$$
$$r_{53} = \frac{1}{\max\{0.8; 0.8; 0.8; 0.8; 1\}} = \frac{1}{1} = 1$$

4. Criteria C4

$$r_{14} = \frac{0.8}{\max\{0.8; 0.65; 0.8; 0.8; 0.65\}} = \frac{0.8}{0.8} = 1$$
$$r_{24} = \frac{0.65}{\max\{0.8; 0.65; 0.8; 0.8; 0.65\}} = \frac{0.65}{0.8} = 0.81$$
$$r_{34} = \frac{0.8}{\max\{0.8; 0.65; 0.8; 0.8; 0.65\}} = \frac{0.8}{0.8} = 1$$
$$r_{44} = \frac{0.8}{\max\{0.8; 0.65; 0.8; 0.8; 0.65\}} = \frac{0.8}{0.8} = 1$$
$$r_{54} = \frac{0.65}{\max\{0.8; 0.65; 0.8; 0.8; 0.65\}} = \frac{0.65}{0.8} = 0.81$$

The result of normalization matrix:

$$R = \begin{bmatrix} 0.8 & 0.65 & 0.8 & 1 \\ 0.8 & 0.65 & 0.8 & 0.81 \\ 1 & 0.8 & 0.8 & 1 \\ 1 & 1 & 0.8 & 1 \\ 1 & 0.8 & 1 & 0.81 \end{bmatrix}$$

The ranking process uses the weights given by the decision-makers:

$$W = [0.25 \quad 0.25 \quad 0.25 \quad 0.25]$$

The obtained results are as follows:

$$V_1 = (0.25\ x\ 0.8) + (0.25\ x\ 0.65) + (0.25\ x\ 0.8) + (0.25\ x\ 1) = 0.812$$
$$V_2 = (0.25\ x\ 0.8) + (0.25\ x\ 0.65) + (0.25\ x\ 0.8) + (0.25\ x\ 0.81) = 0.765$$
$$V_3 = (0.25\ x\ 1) + (0.25\ x\ 0.8) + (0.25\ x\ 0.8) + (0.25\ x\ 1) = 0.9$$
$$V_4 = (0.25\ x\ 1) + (0.25\ x\ 1) + (0.25\ x\ 0.8) + (0.25\ x\ 1) = 0.95$$
$$V_5 = (0.25\ x\ 1) + (0.25\ x\ 0.8) + (0.25\ x\ 1) + (0.25\ x\ 0.81) = 0.902$$

Based on the scores above, if sorted from the highest using the sort descending function, the result is V4-V5-V3-V1-V2 and it has been confirmed that first place is V4 which is Natsha, the runner UP is V5 (Febrio), the first runner up third is V3 (Nurista), and the second runner up is V1 (Wuri).

4.4. System Implementation

This section outlines some features of the DSS. Figure 6 depicts the dashboard of the DSS. The dashboard page will appear if the admin has been successfully login

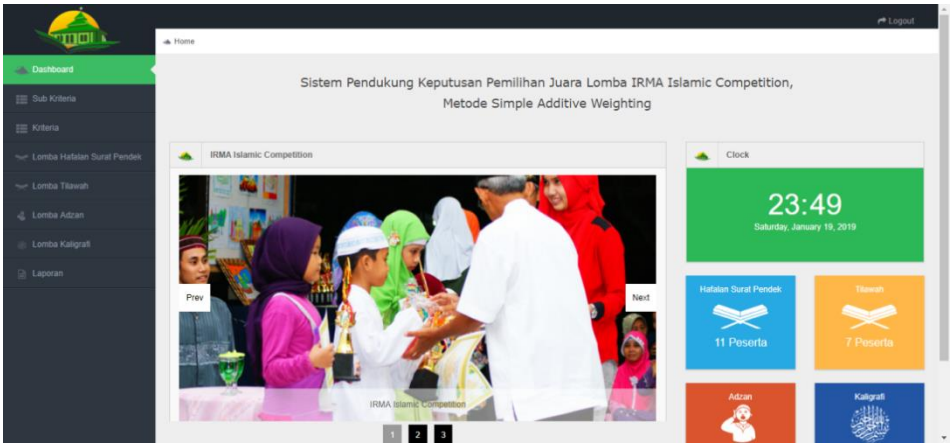

Figure 6. Dashboard page

Figure 7 shows the page for recording the score of the competition. This page contains the participants' form and scores for the Quran recitation competition and displays the information on the recitation criteria and sub-criteria. This page also shows the data entered so that they can be either edited or deleted.

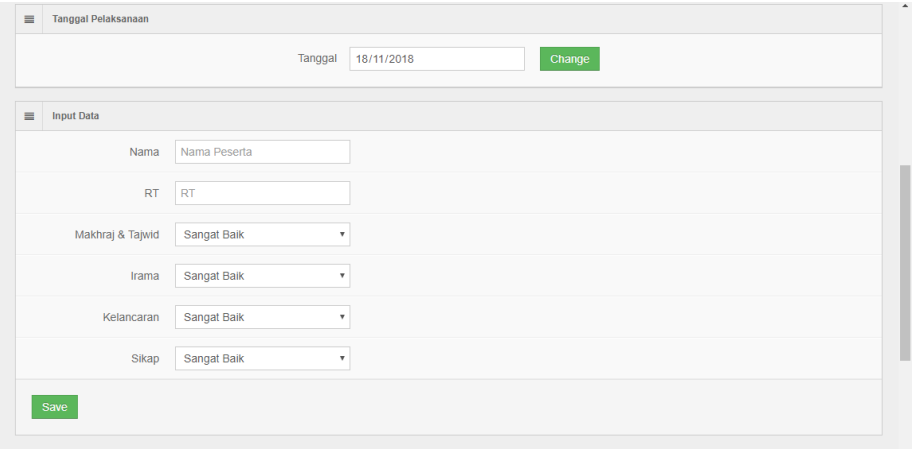

Figure 7. Page of managing a score of the competition

Figure 8 and 9 show the pages to view the reports. The pages present lists of the winners of all categories of the competitions.

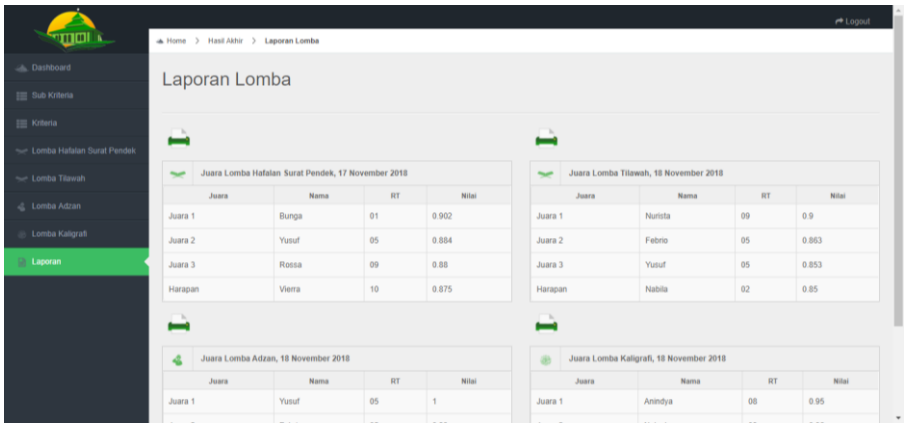

Figure 8. The report page of the DSS

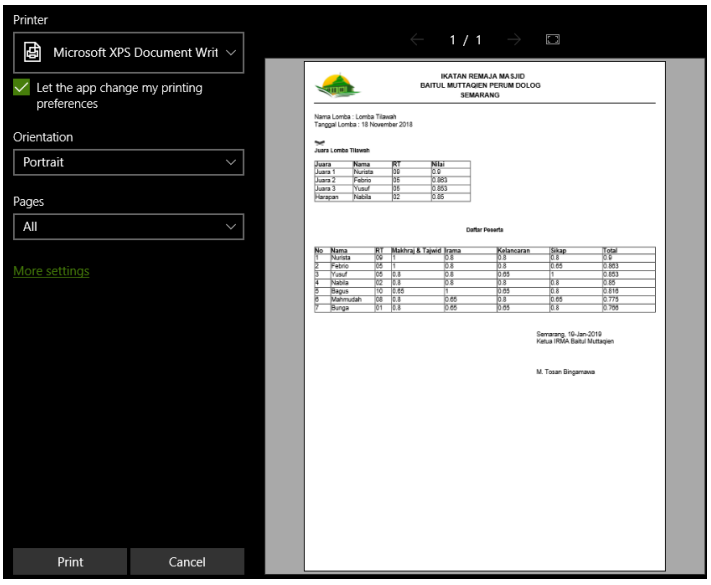

Figure 9 The report in the XPS format

5. Conclusion

This study has examined the use of the SAW to determine the winners of the IRMA Islamic competition. The DSS application has been developed and tested. The use of DSS with the SAW approach helped the committee of the IRMA Islamic competition to decide who is entitled to become a champion. The committee no longer needs to manually calculate the score of the contestants, rather the DSS has calculated the scores automatically. To optimize the use of the DSS, it is necessary to add a data backup feature to prevent permanent data loss. The DSS still needs further development. System requirements analyses are required to develop the DSS in order to fit what is needed.

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